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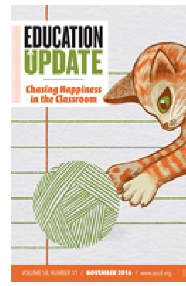
Chasing Happiness in the Classroom Pages 2-3-6



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Minds for Math

Kathy Checkley

Tired of hearing "But, I'm not a math person"? Help your students find meaning and motivation in numbers.

Early in her book *Mathematical Mindsets*, Stanford mathematics professor Jo Boaler shares two charts. One shows the kinds of skills Fortune 500 companies valued in 1970. Second on that list: computation. By 1999, computational skills did not even make the top 10. Today, the consensus among business writers is that most Fortune 500 companies look for interpersonal, analytic, and reasoning skills when evaluating candidates.

Despite this, says Boaler, in too many math classrooms today, the emphasis is still on arithmetic; memorizing formulas; and timed tests that measure how quickly students can add, subtract, multiply, and divide. Students who don't fare well in this kind of environment can "very easily develop a math phobia," Boaler states. "They begin to believe they don't have a brain for math, and they begin to see themselves as less valuable as a person."

Indeed, no educator wants that outcome and Boaler has faith that once teachers see how students respond to "math that is taught conceptually"—when students ponder the ideas that underlie an operation, for example, and when they can reason and justify—there will be no return to an instructional model that serves only a handful of students.

Making Math Relevant

"I wasn't taught in a way that promoted conceptual understanding," says Emily Theriault-Kimmey, who has taught 5th grade math at Pattengill Elementary School in Ann Arbor, Michigan, for more than two decades. Her determination to make math more accessible for her diverse students, however, required her to discard "rote memorization" as an instructional strategy. Theriault-Kimmey, instead, "leverages the wealth of life experiences" her students bring into the classroom and weaves them into her lessons.

She learned, for example, that one of her students shared a room with two siblings. A bunk bed in their room covers half of the wall space. The challenge: how could the siblings divvy up the remaining wall space into three equal sections? To promote conceptual understanding, she asked the class to visualize the space and to create a model that would help them solve the problem. "They were really figuring out what 1/3 of 1/2 is," Theriault-Kimmey explains. Solving problems that involve fractions became interesting and relevant because students were addressing an issue that many of them had experienced—how to get exactly what their siblings received. "Kids can see the math when it becomes real to them."

Another student discussed how, when preparing a family recipe, he only had half of a necessary ingredient. How could he reduce the recipe when all of the ingredient amounts were listed as fractions? "This presented a perfect teachable moment that students could connect with," Theriault-Kimmey explains. "The student brought in the recipe and through careful modeling, the class was able to solve the problem. For example, they were able to determine that 1/2 of 3/4 was 3/8, so they knew how much flour to use in the reduced recipe."

Students "have to feel that there is value in what they are going to learn and that the struggle will pay off in the end," adds Brian Leonard, an advanced placement (AP) calculus and statistics teacher at Lake Hamilton High School in Pearcy, Arkansas. That may mean explaining to students how mastering the content will better position them to excel in other subjects and prepare them for multiple careers. It may also mean giving students opportunities to experience the sheer exhilaration that comes when understanding finally clicks. "Anytime you have a challenge and you struggle to overcome it, you grow as a person," says Leonard.

The latter observation resonates with José Vilson, who teaches 8th grade algebra at Inwood Intermediate School (IS 52) in New York City. He notes that many teachers mistakenly think that if a real-world application of math isn't readily apparent, students won't be inclined

apply themselves—and he takes issue with this conclusion. Math teachers, he asserts, should not have to "qualify" their content. "We don't ask that of other subjects," he says. Vilson believes that his students find math meaningful and relevant when they arrive at a solution after many trials and errors. Their success strengthens their intrinsic motivation. "I've found that success makes my students even more successful."

The Brain on Confidence

Achievement primes the brain to learn more, agrees Judy Willis, author of *Learning to Love Math* (ASCD, 2010). When students are given an appropriate and achievable problem, the brain rewards struggling students who overcome that problem with a dose of dopamine, says Willis. The result is a "deeply gratifying" satisfaction.

What makes for an appropriate challenge? First, students have to understand the problem, asserts Leonard. "We tend to lose students the terminology," he says. "We throw our understanding on them, rather than building on their understanding."

Leonard, as a result, likes to strip his introductory lessons of new vocabulary. "Kids can discuss the ideas without knowing the terminology and I can follow up on what I hear [by saying] 'Hey, when you mentioned that some people may not have responded to a survey, we call that nonresponse bias in statistics.'" When he gets a new crop of calculus students, Leonard reviews graphing quadratic functions by asking students to discuss "that U shape," knowing that some haven't yet encountered the terms *concave up* or *parabola*. This strategy builds confidence because the vocabulary term describes something that the student already knows and allows everyone to start on the same page, Leonard explains.

Teachers must also look for ways to build students' confidence when dealing with "wrong" answers, adds Vilson. An answer may be "technically" wrong, but still be right. For example, if a teacher asks a student to reduce a fraction—25/100—and one student arrives at 5/20, is the student really wrong? "The teacher's assumption is that the student will arrive at 1/4," Vilson explains, but the student may not know to reduce a fraction to its simplest form. The student isn't wrong, "just not all the way there." Vilson says he would use that opportunity to acknowledge what the student does understand while asking guiding questions to help him determine next steps.

Of course, there are times when the answer is either A or B, and students will answer incorrectly. How should teachers respond? They should celebrate, suggests Boaler, who points out that when students make mistakes, "synapses fire and brains grow." Boaler emphasizes this mindset in an online series of math exploration videos (see youcubed.org and follow the navigation to the Week of iMath). In the videos, students are shown how to embrace error and honor the struggle.

Building a classroom culture that values mistakes fosters "persistence and a willingness to keep trying," says Charity Hall, a kindergarte teacher and former math interventionist for Minneapolis Public Schools. Hall recently studied math teachers with growth mindsets to fulfill requirements for her master's thesis. She found that teacher questioning can help students see that mistakes—as well as correct answers—offer opportunities to clarify thinking.

One particular teacher Hall observed would consistently ask, "Could you solve this problem in a different way?" If a student gave a correct (or incorrect) answer, the teacher didn't respond herself. Instead, she asked the class if they agreed with the solution. In doing s writes Hall, the teacher shows students that they "are capable. Answers, in this case, don't come from the teacher, but the students themselves."

A Worthwhile Effort

Boaler acknowledges that she is not the first to take aim at "a narrow and impoverished version of mathematics." Efforts to reform mat instruction in the 1990s led to some "amazing curricula" and a lot of enthusiasm, she notes. Unfortunately, a narrow focus on standardized testing has resulted in instruction that stresses procedural mathematics. Still, Boaler maintains that the effort to emphasi conceptual understanding over computation—and to help all children see that they can learn "beautiful and creative" mathematics—is no less imperative today and students deserve no less.

Leonard agrees, and maintains that he owes it to his students to keep touting the benefits of learning to love math. "I love showing students problems, having them completely stumped, seeing them struggle, and then finally arrive at a solution. The joy on their faces when they reach it is the payoff." Leonard adds that of all subjects, math gives students the most crucial tools for success. "There is no better course in all of school that gives students more opportunity to think critically, and no matter what we do in life, critical thinking is skill we all need."

Boaler adds that students who do well in math perform better in other areas, too. Students with high GPAs in math have similar GPAs i science and language arts, she states. "When we do well in math, it leads to an intellectual empowerment that affects the whole of our lives."

Anatomy of a Lesson

> *Emily Theriault-Kimmey received the Presidential Award for Excellence in Mathematics and Science Teaching in 2014. The 5th grade teacher submitted her "Banana Bread Problem" lesson as part of the application to show how she uses her students' real-life experiences to help them connect to mathematical concepts. In her own words:*
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> "We came across the [banana bread] problem when my upper elementary students helped out during a field day event held at a lower elementary school in our district. The students manned various stations during their lunch hour, so they couldn't eat lunch at the regular time. Parent volunteers decided to bring in banana bread and dropped off loaves at each of the stations.
>
> There was some disagreement about whether the loaves were distributed fairly. So, I decided that the students could figure it out by determining what fraction of the banana bread they received at their stations, which required the students to compare what each station received.
>
> It was determined that some stations received a greater number of loaves than others, but the banana bread was portioned out fairly at each station.
>
> This activity required students to work with fractions and also encouraged mathematical discourse between students—which was a goal. Additionally, I wanted students to see that there are different ways of reasoning mathematically. This problem gave students that opportunity."

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